REMARKS

Present Status of the Application

The Office Action rejected claims 1-7, 9-10 and 12-13 under 35 U.S.C. 103(a), as being unpatentable over Nakamura et al. (U.S. Patent No. 5,691,791) in view of Kim et al. (U.S. U.S. Patent No. 6,038,008). The Office Action also rejected claim 8 under under 35 U.S.C. 103(a), as being unpatentable over Nakamura et al. (U.S. Patent No. 5,691,791) and Kim et al. (U.S. U.S. Patent No. 6,038,008) in view of Kim et al. (U.S. U.S. Patent No. 6,693,689). The Office Action further rejected claim 11 under under 35 U.S.C. 103(a), as being unpatentable over Nakamura et al. (U.S. Patent No. 5,691,791) and Kim et al. (U.S. U.S. Patent No. 6,038,008) in view of Kubo et al. (U.S. U.S. Patent No. 6,819,379). Applicants have added claims 44-53 and amended claims 1, 8, 9 and 12. After foregoing amendment, Applicants respectfully submit that claims 1-13 and 44-55 clearly define the invention and are distinguishable over the cited arts. Hence, the reconsideration of those claims is respectfully requested.

Summary of Applicants' Invention

The Applicants' invention is directed to a liquid crystal display structure capable

of minimizing liquid crystal misalignment in the liquid crystal layer and liquid crystal cell gap non-uniformity problem. More specifically, each pixel portion of the liquid crystal display (LCD) according to the present invention comprises an organic insulating layer, a conformal reflective layer, a dielectric layer and a first transparent conductive layer. The dielectric layer located over the conformal reflective layer possesses an even upper surface in touch with the first transparent conductive layer. Although the organic insulating layer having a non-planar surface is an essential aspect of the LCD structure, the uneven surface of the organic insulating layer may lead to liquid crystal misalignment and liquid crystal cell gap non-uniformity problems. However, the transparent dielectric layer having a relatively planar upper surface is formed over the organic insulating layer. The first transparent electrode over the insulator layer electrically coupled to the thin film transistor serves the purpose of controlling the liquid crystal above it while the conformal reflector serves to reflect the light passing through the transparent electrode. With this structural arrangement, the liquid crystal layer has a uniform thickness throughout and hence problems caused by having a non-planar reflection layer are avoided.

Discussion of Office Action Rejections

The Office Action rejected claims 1-7, 9-10 and 12-13 under 35 U.S.C. 103(a), as being unpatentable over Nakamura et al. (U.S. Patent No. 5,691,791) in view of Kim et al. (U.S. U.S. Patent No. 6,038,008) and stated that the combination of the cited

references can achieve the claimed features of the present invention.

Applicants respectfully traverse this rejection and respectfully submits that claim 1 and newly added claim 44 have been already distinguishable over the cited arts. As stated above, claim1 and 44 recite:

> 1. A liquid crystal display (LCD) structure, comprising a first substrate panel, a second substrate panel, and a liquid crystal layer disposed between the first substrate panel and the second substrate panel, a plurality of pixel portions being formed by respective electrodes for applying a voltage to the liquid crystal layer, each of the pixel portions comprising
>
> an organic insulating layer over the first substrate panel, wherein the surface of the organic insulating layer has a plurality of protrude/recess structures thereon;
>
> a conformal reflective layer over the organic insulating layer, wherein the conformal reflective layer serves as a reflector of light;
>
> **a transparent dielectric layer over the conformal reflective layer, wherein the dielectric layer has a smoother upper surface than the bumpy organic insulating layer**; and
>
> a first transparent conductive layer over the transparent dielectric layer.
>
> 44. A liquid crystal display (LCD) structure, comprising a first substrate panel, a second substrate panel, and a liquid crystal layer disposed between the first substrate panel and the second substrate panel, a plurality of pixel portions being formed by respective electrodes for applying a voltage to the liquid crystal layer, each of the pixel portions comprising
>
> an organic insulating layer over the first substrate panel, wherein the surface of the organic insulating layer has a plurality of protrude/recess structures thereon;
>
> a conformal reflective layer over the organic insulating layer, wherein the conformal reflective layer serves as a reflector of light;
>
> **a transparent dielectric layer over the conformal reflective layer, wherein the dielectric layer has a smoother upper surface than the bumpy organic insulating layer;**
>
> a first transparent conductive layer over the transparent dielectric layer; and
>
> **a liquid crystal alignment layer located between the first**

transparent conductive layer and the liquid crystal layer.

(Emphasis added). Applicants assert that claims 1 and 44 patently defines over the cited art for at least the reason that the cited art fails to disclose at least the features emphasized above.

The present invention is directed to a liquid crystal display structure having a first substrate panel, a second substrate panel and a liquid crystal layer disposed between the first substrate panel and the second substrate panel, wherein each pixel portion of the liquid crystal display (LCD) comprises an organic insulating layer, a conformal reflective layer, a dielectric layer and a first transparent conductive layer. The organic insulating layer 66 having a rough surface is located over the first substrate panel 50b of the LCD (shown in Fig. 2). The conformal reflective layer 82 is formed on the organic insulating layer (shown in Fig. 2). The transparent dielectric layer 84 with a thickness greater than 1 micron located over the conformal reflective layer **possesses an even upper surface** in touch with the first transparent conductive layer 86 (shown in Fig. 2). Moreover, **the first transparent conductive layer 86 is electrically coupled to the thin film transistor 68.** Notably, the uneven surface of the organic insulating layer 66 may lead to liquid crystal misalignment and liquid crystal cell gap non-uniformity problems. But **the transparent dielectric layer 84 having a relatively planar upper surface is formed over the organic insulating layer 66**. With this structural arrangement, the liquid crystal layer has a uniform thickness throughout and hence problems caused by

having a non-planar reflection layer are avoided.

However, in the cited art (U.S. Patent No. 5,691,791), Nakamura et al. merely provide a reflective type liquid crystal display structure. In the Office Action, the Examiner alleged that the liquid crystal alignment layer 294 of the cited art is functionally and physically equal to the dielectric layer of the present invention. However, Applicants respectfully disagree with this indication. It is well known in the art that the liquid crystal alignment layer is an essential element in the liquid crystal display and usually is very thin with a thickness of about 1000 angstroms and has no surface planarizing function as the transparent dielectric layer 84 in the current invention. Normally, the liquid crystal alignment layer is positioned at both upper surface and the lower surface of the liquid crystal layer and directly in contact with the liquid crystal layer. The attached file labeled as Exhibit A is an article extracted from a website, http://www.dic.co.jp/eng/rd/topics/liquid.html, maintained by DAINOPPON INK AND CHEMICALS, INC.. On the webpage, it clearly shows that "Alignment of liquid crystal molecules is essential for liquid crystal displays. Liquid crystal alignment layers are prepared on the liquid crystal side of the substrates." (page 1, lines 1-2). Although in the present invention, the liquid crystal alignment layer is not specified in both of the specification and the drawings, people skilled in the art will still understand that the liquid crystal alignment layer do exist between the liquid crystal layer and the first transparent conductive layer 86 (Fig. 2). Applicants respectfully assert that **liquid crystal alignment layer 294 of the cited art is neither functionally nor physically**

equal to the dielectric layer 84 of the present invention.

Therefore, it is clear that Nakamura et al. neither teach nor suggest that a dielectric layer having planar upper surface is located over the reflection electrode 288. Furthermore, in the cited art, it is clear that the reflection electrode 288 is electrically coupled to the thin film transistor 290 to control the projection operation (Fig. 27). Also, Nakamura et al. silence about forming a conductive transparent layer having a smooth upper surface over the dielectric layer and in contact with the thin film transistor in order to provide a uniform cell gap of the liquid crystal. It is reasonable that Nakamura et al. never consider that the liquid crystal misalignment and liquid crystal cell gap non-uniformity problems and Nakamura et al. never raise any idea to solve these problems.

Furthermore, in another cited art, U.S. Patent No. 6,038,008, Kim et al. disclose a **transmissive type** liquid crystal display. That is, the transparent ITO layer is used as a pixel electrode 104 which is electrically coupled to the thin film transistor (shown in Fig. 7H of the cited reference) for controlling the transmittance of the liquid crystal display and is formed on the roughened surface of the protection layer. In the Office Action, the Examiner inferred that the pixel electrode 104 physically and functionally indicates the transparent conductive layer of the present invention and the protection layer 126 physically and functionally equal to the dielectric layer of the present invention. However, Applicants respectfully traverse these indications. **It is understood that the operating mechanism of the transmissive type liquid crystal display is different from that of the reflective type liquid crystal display. People**

skilled in the art will not refer to a transmissive type liquid crystal display for the manufacturing of a reflective type liquid crystal display.

Additionally, Kim et al. emphasize that the protection layer is made of an organic insulating material (col. 7, lines 41-43) and the surface of the protection layer is roughened by sputter etching to increase the adhesion to an ITO (indium tin oxide) layer (col. 7, lines 44-47). That is, the protection layer 126 would be functionally and physically equal to the organic insulating layer 66 (Fig. 2 of the present invention) mentioned by the present invention. In addition, even though the protection layer 126 works as the dielectric layer mentioned in the present invention, Kim et al. also fails to teach or suggest that the surface of the protection layer 126 should be planar. Even if the surface of the protection layer 126 would be even, the protection layer 126 having an even upper surface would not possess the high adhesion ability to the ITO layer which is totally against the goal of the cited reference provided by Kim et al (col. 7, lines 45-47).

Hence, Kim et al. do not teach to form a transparent dielectric layer with an even upper surface over the conformal reflective layer on an uneven surface. Furthermore, it is clear that the pixel electrode 104 of transparent characteristic is electrically coupled to the thin film transistor for controlling the transmittance of the liquid crystal display so that the liquid crystal display disclosed by Kim et al. is a transmissive type liquid crystal display. **Consequently, there is no motivation for combining the cited arts since Nakamura et al. provide a reflective type liquid crystal display and Kim et al.**

disclose a transmissive type liquid crystal display. Further, even if people skilled in the art combined Nakamura et al. with Kim, the combination result would not obtain the same advantages and features as the present invention possesses. Applicants respectfully submit that claims 1 and 44 are believed to patentably distinguish over the combination of the prior arts.

Newly Added Claims

Applicants have added claims 44-55 for further limiting the present invention by introducing a liquid crystal alignment layer located between the first transparent conductive layer and the liquid crystal layer. Since the concept of the liquid crystal alignment layer located at both upper surface and the lower surface of the liquid crystal layer and directly in contact with the liquid crystal layer is well known in the art (shown in Exhibit A), it is believed that no new matter is introduced into the application by adding the new set of claims.

For at least the foregoing reasons, Applicants respectfully submit that independent claims 1 and 44 patently defines over the prior art references, and should be allowed. For at least the same reasons, dependent claims 2-13 and 45-55 patently define over the prior art as well.

Customer No.: 31561
Application No.: 10/065,091
Docket NO.: 5486-US-PA

CONCLUSION

For at least the foregoing reasons, it is believed that the pending claims 1-13 and 44-55 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,

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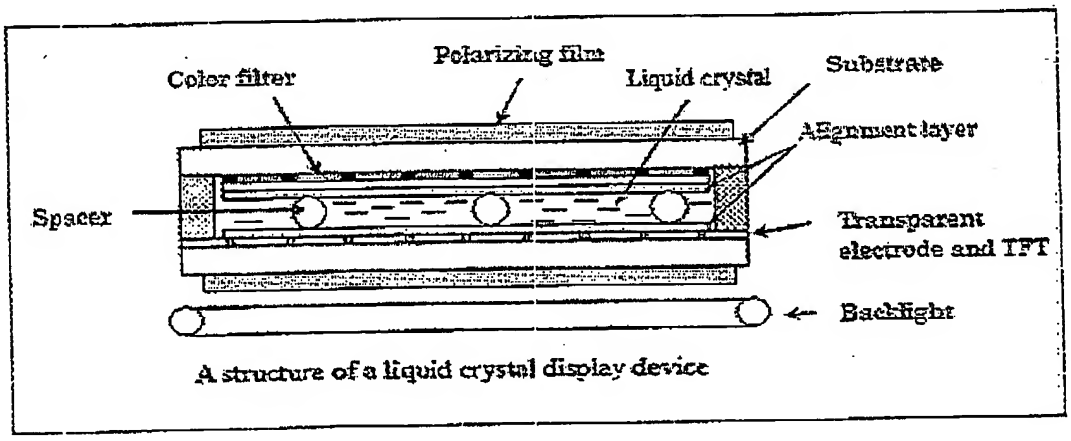
Exhibit A

http://www.dic.co.jp/eng/rd/topics/liquid.html

Alignment of liquid crystal molecules is essential for liquid crystal displays.

Liquid crystal alignment layers are prepared on the liquid crystal side of the substrates.

A cross section of a typical liquid crystal display device is shown below.



A structure of a liquid crystal display device

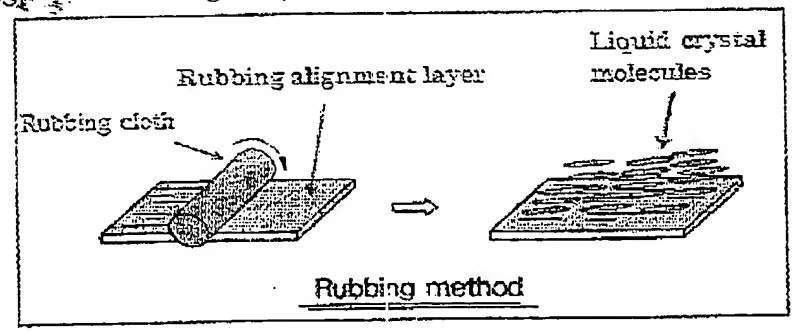
We developed a novel liquid crystal alignment layer in collaboration with The Hong Kong University of Science and Technology.

The conventional preparation method for the alignment layer

1. Solution of polyimide or polyamic acid are coated onto the substrate.
2. After baking the coated layer, it is rubbed using cloth.
3. The property of the surface is changed along the rubbed direction.
4. Liquid crystal alignment along the direction is achieved by this method.

Exhibit A

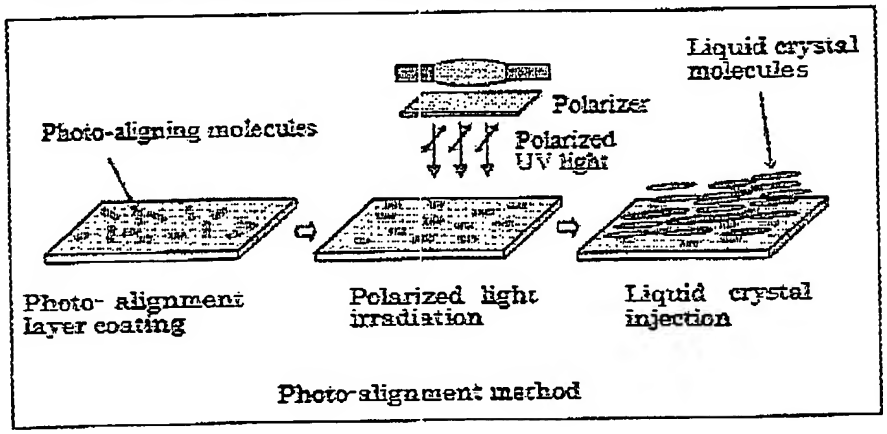
The rubbing by cloth sometimes causes dust contamination to the liquid crystal cell or generates static, which may destroy TFT fabricated on the substrate. These disadvantages of the rubbing method can degrade yields in production of the liquid crystal devices.



- - - Non-contact method for liquid crystal alignment

1. A layer of a compound with photo-reactive moiety is coated on the substrate.
2. Anisotropical chemical reaction is induced by polarized UV light irradiation to the layer.
3. Alignment of liquid crystal molecules are achieved after using this method.

Generally, anchoring energy, which is energy to fix liquid crystal molecules to an objective direction, by this method is smaller than rubbing method.

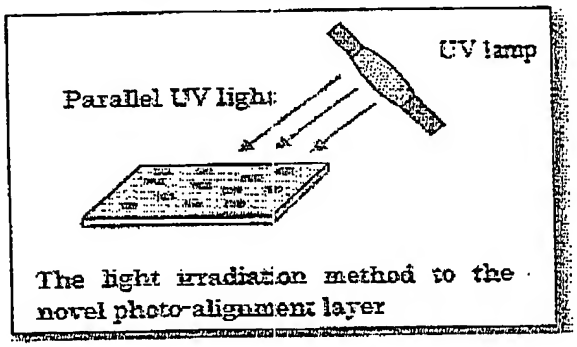


How to prepare the novel photo-alignment layer for liquid crystal

Exhibit A

1. The solution of the newly developed low-molecular weight azo dye derivative is coated on a substrate.
2. And the molecules in the layer are reoriented by obliquely irradiation of UV light.
3. After this, the reoriented molecules are fixed by heating.
4. Alignment of liquid crystal toward the objective direction is achieved after using this method.

Degradation of light energy from the UV lamp can be made less because of needlessness of the polarizer. Therefore this method is suitable for mass production.
And it has succeeded to make the anchoring energy as large as that of the rubbing layer.



Please also refer to the paper, "Liquid Crystal Alignment Materials Using Low Molecular-weight Azo Dye Derivatives".

Contact us.

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